Group velocity for Rossby waves (simple case, U=0 and l = 0)

$$(\vec{c}_g)_x = \frac{\partial \nu}{\partial k}$$

What is ν? We have $\nu = ck =$ Uk – βk/(k²+l²), so

$$\left(\vec{c}_g\right)_x = \frac{\partial \nu}{\partial k} = \frac{\partial}{\partial k}\left\{Uk - \frac{\beta k}{k^2+l^2}\right\} = \frac{\partial}{\partial k}\left\{-\frac{\beta k}{k^2+l^2}\right\}$$

or,

$$\left(\vec{c}_g\right)_x = \left\{-\frac{\beta}{k^2+l^2}\right\}\frac{\partial}{\partial k}\{k\} - k\frac{\partial}{\partial k}\left\{\frac{\beta}{k^2+l^2}\right\}$$

$$\left(\vec{c}_g\right)_x = \left\{-\frac{\beta}{k^2+l^2}\right\} - \frac{\beta k}{(k^2+l^2)^2}\frac{\partial}{\partial k}\{-k^2\}$$

$$\left(\vec{c}_g\right)_x = \left\{-\frac{\beta}{k^2+l^2}\right\} + \frac{2\beta k^2}{(k^2+l^2)^2} = \frac{2\beta k^2}{(k^2+l^2)^2} - \left\{\frac{\beta(k^2+l^2)}{(k^2+l^2)^2}\right\}$$

$$\left(\vec{c}_g\right)_x = \left\{\frac{\beta(k^2-l^2)}{(k^2+l^2)^2}\right\}$$

For l = 0, then

$$\left(\vec{c}_g\right)_x = \left\{\frac{\beta}{k^2}\right\}$$

This is the opposite sign of

$$c_x = -\left\{\frac{\beta}{k^2}\right\}$$

for the same case. Thus the wave form moves to the west, but the energy propagates to the east.